

## **A Simulation Recruitment Tool for Engineering Management**

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### Abstract

This article summarizes the application of the Palmtop Simulation Program within the “Introduction to Engineering ‘98” a summer program for high school juniors and seniors offered at the University of Missouri-Rolla. The simulation model provides an enjoyable experience for young students without business background to make decisions related to the new product innovation process and highlights the usefulness of business skills for engineers. It also summarizes the results of a survey given to the students after their simulation experience. The survey represents the students’ perception of how much they learned about the importance of business related skills.

### Introduction

One of the recruiting challenges for the undergraduate program in Engineering Management is the lack of awareness of high school students of our discipline and the value that it provides. Many students visualize engineers working in isolation creating technologically innovative products. However much of the real work of engineers is based on interactions with others, product costs, customer needs, communication, motivation of others, trade-off’s in resource allocation, and interdisciplinary teams. The Engineering Management program prepares the students for these roles, but it is difficult for high school or early undergraduate students who have no industrial experience to recognize this need.

The Palmtop Simulation Program © is created to allow students to experience the real issues of decision making in a high technology company. They experience the importance of business issues such as marketing, management, finance and engineering economics within a team environment. The students are formed into teams that compete with each other to make the most profitable palmtop computer business. As they allocate resources to design and produce the palmtop computer they learn the importance of designing a product line that meets customer needs and makes a profit. They work in teams to make these decisions, compare their results, and reflect on their performance and how it could have been improved. As a result, they better understand how Engineering Management helps them become more effective engineers who can deal in the world of business and help their firms focus on the most important problems. The simulation allows them to visualize how the degree will allow them to function as an engineer and use marketing, finance, engineering economics, accounting, management information systems, management, manufacturing and production, to become more effective and successful. The simulation is handled with a Microsoft Excel worksheet that is intended for use with

computer projection so that the interim and final results can be displayed for all to see as the simulation progresses.

## Objectives

This simulation program was developed for the Introduction to Engineering '98 hands-on program for high school juniors. This is a week program in which the students get an opportunity to explore various engineering disciplines and experiences to help them make career decisions and college selection decisions. The University of Missouri – Rolla (UMR), offers it as an educational and recruiting tool. The department hopes to educate the students on the discipline and also recruit these students to come to the campus and also to the department.

It is the objective of the simulation to make the students visualize how engineering knowledge might be used after graduation and the additional value provided by the Engineering Management degree. On the other hand, it is not intended to accurately assess the value of the decisions made by the teams. In the simulation environment there are many factors that determine the success of these teams and luck is one of them. Similar to real life, organizations can make good decisions without full understanding of the underlying principles. However this model offers an opportunity for reflection after the fact that can clarify those underlying principles and highlight their value.

## Methodology

In the simulation session, the students are formed into two to four competitive teams, with two to five students per team. This allows for interactive groups of four to twenty students to participate in the simulation. For larger groups, some of the team members are selected to represent the others and make the decisions. The teams compete with each other to generate the greatest profit. To simplify the preparatory work necessary, the model does not require specific knowledge in technical or business areas from the participants.

The session begins with introductory comments that describes the situation, the rules and the objectives. This is done orally through the facilitator's comments, visually through a PowerPoint presentation (palmtop.ppt), and textually with a two-page handout that explains the same material (palmtop.doc). The various media facilitates the students with different learning styles and the document gives them something to review while they are making their decisions. They are then given some time to make the first set of decisions which represent the business decisions to allocate the available funds to various activities that impact the product characteristics that affect new product success, such as cost, functionality and quality. These results are collected and the decisions by each of the teams are displayed. This simulates the competitive environment, in which the firms become aware of the existence of competitors in a common new product market. Based on this feedback, the students become more aware of the competitive nature of their market and their competitive position. They have another chance to make incremental business decisions to better position themselves. Once these final decisions are made the spreadsheet model calculates the results for the teams. While the students watch, the market decision rules are applied that determine which team is selected by the customers and the level of profitability for each team. This determines the winning team. The session concludes

with discussions that allow for reflection in which the value of the Engineering Management education is highlighted.

The simulation is designed for 90 minutes sessions, but it can be used for sessions lasting 50 minutes to two hours. However, the 50-minute session limits the amount of time the teams have to understand the situation and reach group consensus. At first, the teams do not see the relationships among the resource allocation decisions and market success. There are hints provided to offer some direction, but it is through the team discussions that these relationships become more visible. It is after these discussions that the student teams are primed to appreciate the value of understanding the underlying concepts that affect business success.

The Palmtop Simulation places the students in the midst of a new product development process, which is summarized as follows. The palmtop computer is being designed and will be ready for sale in two years, but decisions need to be made on the allocation of investment capital to support this development. As a team they need to make critical decisions that will determine the profitability of this enterprise. Given limited financial resources, the teams decide how much to spend on market and manufacturing studies, incremental component cost, manufacturing equipment, and projects to reduce cost, increase functionality, improve reliability and make it more visually appealing. The teams also decide the price that will be charged for the product.

The marketing study offers insight into the product characteristics that customers value. There are two types of customers: the basic and the elite customers. While the basic customer is looking for a low cost product that performs the basic functions, the elite customer looks for a more powerful computer, with higher reliability and visual aspect that reflects the superior product. The marketing study describes these customers and the size of each market and it can give a team insights that can generate competitive advantages for the team. The cost of the study is set to discourage some of the teams from purchasing the studies. These teams choose to save money and depend on luck to win since they do not understand what features their customers value. Similarly there is a manufacturing study that can be purchased by the teams. It provides information about the equipment that is preferred for the assembly of the optional components. Those teams that choose not to invest in this study might utilize the wrong equipment and produce goods with poor quality.

Another area of learning for the students comes from the timing of the decisions. Those decisions that are made early in the development process have a greater impact than those made late in the process. For example, cost reduction investments made in the first year have a greater impact on product cost than a similar investment on the second year, since by this time many of the basic design decisions have already been made. This shows the students the importance of making the right decision the first time, and not to procrastinate on decisions, merely because all the information is not available.

The spreadsheet (palmtop.xls) provides two functions. It displays the decisions made by all the teams to create a competitive environment. Once all the teams have turned in their decisions, the computer projector displays them. The spreadsheet also calculates the value factors for each team that simulate how much value a basic customer would give to their product and how much value an elite customer would give, based on the decisions made by the team. For example, large

investments in cost reduction efforts would reduce cost and improve the value to the basic customer, but have less impact to the elite customer. Based on the value factors, the manufacturing capacity of the firms, and the price, the elite and basic customers choose from which team to purchase their computer. This generates the volume of sales for each team. The product cost is also calculated by the system. It is a function of the decisions made that selected the manufacturing equipment, added optional components, and lowered the cost through investments in cost reduction. Based on the volume of sales, the price charged by unit, unit costs, and initial investment, profitability is calculated for each team. The team with the greatest profits, or minimum loss wins the game.

Once the underlying principles are understood, it is easy for the students to understand why they made or lost money. They can see the folly of designing a product without understanding what the customers value, and recognize the value for marketing. Profits are the measure of success in the real world, and it becomes clear why it is important to be able to use accounting, engineering economics and finance. The simulation also provides the experience to value management, manufacturing, quality and management information system courses. It helps to show that the Engineering Management degree will help the students become competent engineers who can deal in the world of business and help their firm solve the most important problems.

### Implementation

In July 1998 the Palmtop Simulation was utilized with three groups of high school seniors participating in the "Introduction to Engineering '98" Program. These students had chosen to visit the Engineering Management Department as one of their three department choices among eight participating departments. Once in the department they chose from four different activities, one of which was the business simulation session. A total of 30 students participated in sessions and they ranged from eight to thirteen students per session.

### Impact Assessment Survey

In order to assess the impact of the simulation to the students learning, a survey was given to all the participants. The objective was to assess how much this simulation helped the students understand the importance of the business related courses taught in the engineering Management Department, as well as the value of the Engineering Management B.S. degree. Each student was asked to assess their initial understanding and their understanding at the conclusion of the simulation. They were asked to assess whether their level of understanding was "very high" = 1, "high" = 2, "medium" = 3, "low" = 4, and "not at all" = 5. In average the student understanding improved from 3.45 (between medium and low) to 1.75 (between very high and high). This reflects a very large improvement of 1.7 on our 5-point scale.

As a comparison, we asked these students to similarly assess two sessions from other departments. These improved from an average of 3.12 to 2.29 for an average improvement of 0.83, which is about a half of the improvement measured in the simulation session. In general the students began the Engineering Management session with less understanding about the discipline than other departments, but ended with a better understanding.

It is to be expected that the results of this survey be biased towards the simulation session since it had just occurred and the developer of the simulation collected the survey. However, these strong survey results support that simulation is an effective way to help the students learn the importance of business-related courses and the Engineering Management degree.

## Summary

The Palmtop simulation session is a fun and educational way to introduce students to the value of an Engineering Management undergraduate education. It can be utilized for a large range of student size and utilizes a hands-on, cooperative learning approach. The impact assessment survey measured a significant level of learning during the simulation session. If interested in using this simulation model, contact the author for access to the simulation model and a set of detailed support documents.

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